

AD-A033 994

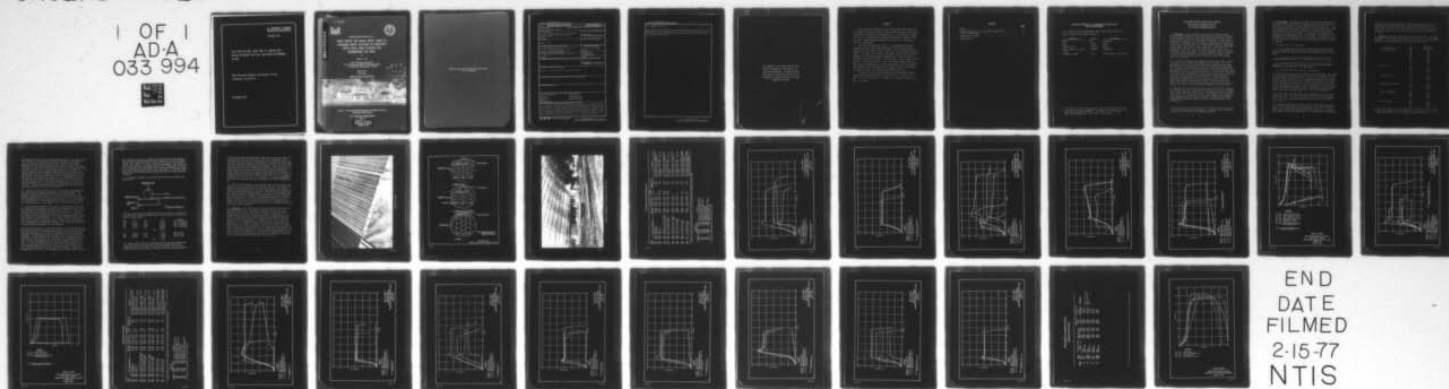
ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MISS F/G 1/5
SKID TESTS ON XM18, XM19, AND T11 LANDING MATS PLACED IN CONTAC--ETC(U)
NOV 76 G L CARR

UNCLASSIFIED

WES-MP-S-76-23

NL

1 OF 1
ADA
033 994



U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

AD-A033 994

SKID TESTS ON XM18, XM19, AND T11 LANDING MATS
PLACED IN CONTACT WITH SOIL AND PLACED ON MEMBRANE
ON SOIL

ARMY ENGINEER WATERWAYS EXPERIMENT STATION
VICKSBURG, MISSISSIPPI

NOVEMBER 1976

010026



MISCELLANEOUS PAPER S-76-23

**SKID TESTS ON XM18, XM19, AND T11
LANDING MATS PLACED IN CONTACT
WITH SOIL AND PLACED ON
MEMBRANE ON SOIL**

by

Gordon L. Carr

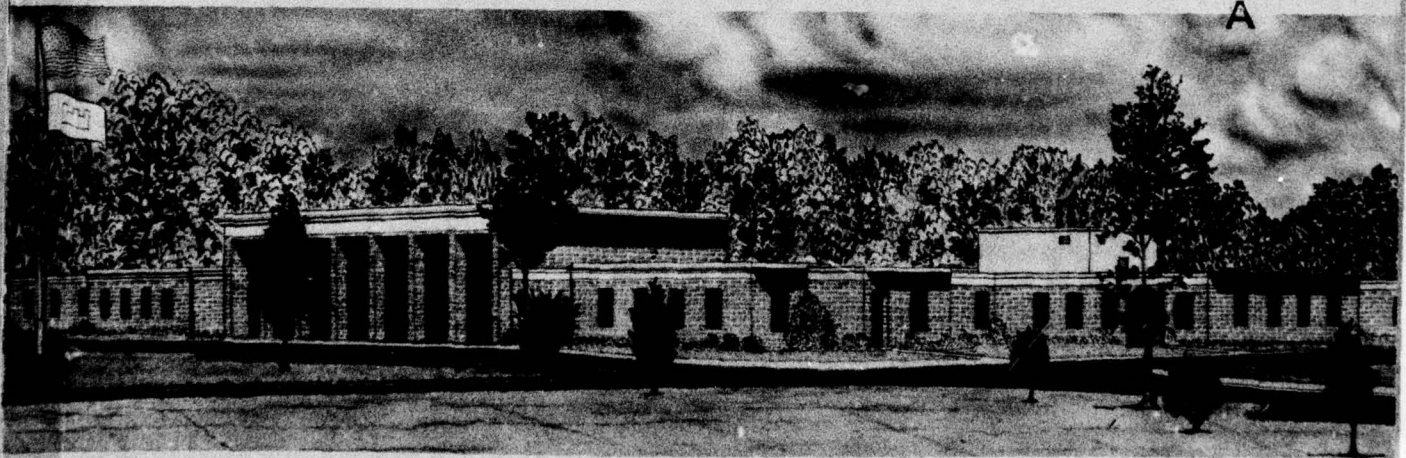
Soils and Pavements Laboratory
U. S. Army Engineer Waterways Experiment Station
P. O. Box 631, Vicksburg, Miss. 39180

November 1976

Final Report

Approved For Public Release; Distribution Unlimited

DDC
RECEIVED
JAN 3 1977
A



Prepared for U. S. Army Materiel Development and Readiness Command
Alexandria, Virginia 22333

Under Project No. IG764717DH01
Task 10

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

Destroy this report when no longer needed. Do not return
it to the originator.

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER Miscellaneous Paper S-76-23	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) SKID TESTS ON XM18, XM19, AND T11 LANDING MATS PLACED IN CONTACT WITH SOIL AND PLACED ON MEMBRANE ON SOIL		5. TYPE OF REPORT & PERIOD COVERED Final report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Gordon L. Carr		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U. S. Army Engineer Waterways Experiment Station Soils and Pavements Laboratory P. O. Box 631, Vicksburg, Miss. 39180		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Project No. 1G764717DH01 Task 10
11. CONTROLLING OFFICE NAME AND ADDRESS U. S. Army Materiel Development and Readiness Command Alexandria, Va. 22333		12. REPORT DATE November 1976
14. MONITORING AGENCY NAME & ADDRESS (If different from Controlling Office)		13. NUMBER OF PAGES 37
		15. SECURITY CLASS. (of this report) Unclassified
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) <div style="display: flex; justify-content: space-between;"> <div> Anchors (Fasteners) Coatings Landing mats Membranes Skid resistance </div> <div> Skid tests T11 landing mat XM18 landing mat XM19 landing mat </div> </div>		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Tests were performed on landing mats and membranes to evaluate the anti-skid properties of paints and antiskid coating when each was in contact with a loaded rubber tire, and/or when each was in contact with soil or membrane. The data were used to determine the forces which were transmitted through the mats to the underlying materials and which the anchors would have to resist to prevent mat movement under a braking aircraft tire. Panels with antiskid on both sides increased the resistance of panels to sliding along the (Continued)		

DD FORM 1 JAN 73 1473

EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

20. ABSTRACT (Continued).

ground, which in turn reduced the forces transmitted to the mat anchors. Test data indicated that the anchors would have to resist greater forces produced by aircraft braking when the mats were placed on membrane than when the mats were placed directly on soil.

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

THE CONTENTS OF THIS REPORT ARE NOT TO BE
USED FOR ADVERTISING, PUBLICATION, OR
PROMOTIONAL PURPOSES. CITATION OF TRADE
NAMES DOES NOT CONSTITUTE AN OFFICIAL EN-
DORSEMENT OR APPROVAL OF THE USE OF SUCH
COMMERCIAL PRODUCTS.

REGISTRATION NO.	
DATE	
FILE	
CLASSIFICATION	
REMARKS	
BY	
DATE	
INITIALS	

A

Preface

This study was conducted as a part of the work authorized by the Troop Support Division (formerly Ground Mobility Division), Directorate of Research, Development, and Engineering, U. S. Army Materiel Command (now the U. S. Army Materiel Development and Readiness Command), under the title "Combat Engineer Equipment," DA Project No. 1G764717DH01, Task 10, "Landing Mat."

The study was performed at the U. S. Army Engineer Waterways Experiment Station (WES) during March-April 1972 under the general supervision of Mr. James P. Sale, Chief, Soils and Pavements Laboratory (S&PL). Personnel of the Materiel Development Division, S&PL, actively engaged in the planning, testing, analyzing, and reporting phases of the study were Messrs. William L. McInnis, Hugh L. Green, Dewey W. White, Carroll J. Smith, and Gordon L. Carr. The Pavement Design Division, S&PL, had the responsibility for coordinating the test, test personnel, and equipment, under the supervision of Messrs. Ronald L. Hutchinson and Cecil D. Burns. This report was prepared by Mr. Carr.

Directors of WES during the conduct of the study and the preparation and publication of this report were BG E. D. Peixotto, CE, COL G. H. Hilt, CE, and COL J. L. Cannon, CE. Technical Director was Mr. F. R. Brown.

Contents

	<u>Page</u>
Preface	2
Conversion Factors, U. S. Customary to Metric (SI)	
Units of Measurement	4
Memorandum For Record	5
Inclosures 1-23	

Conversion Factors, U. S. Customary to Metric (SI)
Units of Measurement

U. S. customary units of measurement used in this report can be converted to metric (SI) units as follows:

<u>Multiply</u>	<u>By</u>	<u>To Obtain</u>
inches	25.4	millimetres
feet	0.3048	metres
pounds (force)	4.448222	newtons
pounds (force) per square inch	6.894757	kilopascals
Fahrenheit degrees	0.555	Celsius degrees or Kelvins*

* To obtain Celsius (C) temperature readings from Fahrenheit (F) readings, use the following formula: $C = (5/9)(F - 32)$. To obtain Kelvin (K) readings, use: $K = (5/9)(F - 32) + 273.15$.

SKID TESTS ON XM18, XM19, AND T11 LANDING

MATS PLACED IN CONTACT WITH SOIL

AND PLACED ON MEMBRANE ON SOIL

1. Background. With the advent of heavy aircraft with multiwheel gears, it became evident that additional data were needed on the anchor restraining force for mats. Since the anchors restrain forces transmitted through the mats, the frictional coefficient of the mat surface determines the magnitude of these forces. Some data on coefficients of friction for the subject mats with antiskid coating and for painted mat surfaces were available at the U. S. Army Engineer Waterways Experiment Station (WES). For example, these values are: coefficient of friction of antiskid-coated mat $\mu_a = 0.67$; coefficient of friction of the painted mat $\mu_p = 0.40$. Also, the forces to produce these coefficient of friction values were known. The force required to produce skidding of a 30,000-lb* loaded C-5A tire (similar data are available on the C-130 tire) on the antiskid surface is 20,100 lb and on the painted surface is 12,000 lb.

2. Using this information, WES computed the force that would be transmitted to an anchor behind the skidding tire as follows: If a force were applied to the tire on landing mat with an antiskid-coated upper surface with the painted surface of the mat in contact with underlying soil or membrane, no movement would occur until the force exceeded approximately 12,000 lb. At forces above this, the painted surface of the mat would move along the ground or membrane. If the mat were restrained from sliding with a dynamometer when the applied force reached 20,000 lb (when the tire would skid on the antiskid), the restraining force recorded by the dynamometer would be 8,000 lb. Simply stated, the painted mat surface would react or restrain forces up to 12,000 lb; forces from 12,000 to 20,000 lb would have to be restrained by the anchor (i.e. 20,000 lb to skid on antiskid; 12,000 lb to skid on paint; 20,000 - 12,000 or 8,000 lb required to restrain or anchor the mat).

3. Some data on record for the coefficient of friction of the painted mat surfaces (μ_p) were considerably lower than that used in the example, and if used, would give a higher value than 8000 lb required to restrain or anchor the mat. The smaller the μ_p , the greater is the required anchor force. By using these or similar data, WES has made recommendations regarding the anchor forces required to restrain certain mats. Test data were needed to support or refute the above hypothesis and computations.

* A table of factors for converting U. S. customary units of measurement to metric (SI) units is presented on page 4.

4. Test program. Coefficient of friction tests were performed with a C-5A tire loaded to 30,000 lb with 100-psi tire inflation pressure on a dry surface. Two series of tests, called "A" and "B," were run. The A-series was performed with the load wheel on mat on membrane on a lean clay subgrade which had a CBR strength of 24. The B-series of the tests was identical with the A-series, except that the mats were placed directly on the lean clay subgrade. In subseries "a," the mats were anchored with a dynamometer in the anchor system to determine the force transmitted from the skidding tire to the ground. In subseries "b," the mats were not anchored but were free to move with the force applied to the load cart or to resist this force by staying in place on the soil or membrane.

5. The objectives of the tests were:

a. To determine the coefficient of friction of the mat surfaces coated with antiskid material and with paint when each was in contact with the loaded tire and/or when each was in contact with soil or membrane.

b. To determine the force transmitted through the mats to the anchored dynamometer when the tire was skidded on the mat surfaces.

c. To evaluate the effectiveness of ways proposed to increase the resistance of the mats to movement along the soil or membrane when braking forces were applied to the mat surface.

d. To validate WES data specified in paragraph 1.

6. Tests were performed on XM19, XM18, and T11 landing mats. Each type of mat was coated with paint on the bottom surface and with antiskid on the top surface. The XM18 mat used in one test series and all of the nested T11 mats (nested to produce a symmetrical top and bottom surface) (Incl 1) had antiskid on both the top and bottom surfaces. The layout for each mat test is shown on Incl 2. In each test, the wheel or mat was to be skidded from 6 to 10 ft and the force was to be recorded on an electric recording oscillograph. Force was applied to the load cart by a four-wheel electric drive prime mover. Inclosure 3 shows the prime mover, skid cart, and dynamometers in a typical test arrangement.

7. The test data for the A-series (mat on membrane on soil) are tabulated on Incl 4. These data were extracted from the plots for each test (Incls 5-12). Data for the B-series (mat on soil) are tabulated on Incl 13. These data were extracted from the plots for each test (Incls 14-21).

8. Additional coefficient of friction tests, identified as tests 5-8 on Incl 22, were performed on half panels of T11 and XM18 by applying force to the loaded panel to produce skidding of the mat. In all of these tests, the antiskid-coated surface was down (panels were upside down) when the panel was skidded both on the ground and on the membrane.

The panel was initially loaded with a 2000-lb weight for each test. The coefficient of friction values were higher than normal because the panels dug into the soil and the data were not considered valid (Incl 22, tests 1-4). Duplicate tests were performed using a 1000-lb loading on the panels; these data are recorded on Incl 22, tests 5-8, and plotted on Incl 23.

9. Analysis. Selected relevant data were extracted from the inclosures and are presented below in tabular form as they relate to the applicable analysis. The coefficients of friction for similar test conditions are shown below in descending order of the average coefficients.

<u>Condition</u>	<u>Test</u>	<u>Coefficient of Friction</u>
Tire to antiskid	A1a	0.68
	A3a	0.68
	A7a	0.68
	B1a	0.68
	B3a	0.72
	B7a	<u>0.69</u>
	Avg	0.69
Paint to soil	B1b	0.65
	B3b	0.57
	B7b	<u>0.56</u>
	Avg	0.59
Antiskid to soil	5*	0.58
	7*	<u>0.54</u>
	Avg	0.56
Antiskid to membrane	6*	0.53
	8*	<u>0.54</u>
	Avg	0.535
Paint to membrane	A1b	0.47
	A3b	0.57
	A7b	<u>0.49</u>
	Avg	0.51
Tire to paint	B2b	0.48
	B4a	<u>0.50</u>
	Avg	0.49

* Mats were skidded on soil or membrane. (In other tests, the measurements were made when the load cart was skidded on the mat.)

The only trend that is not in the anticipated order is the paint-to-soil coefficient of 0.59 being greater than the antiskid-to-soil value of 0.56. The former value has one high value (0.65) in the figures averaged (test B1b, XM19 mat) and without using this value, the coefficients of friction for antiskid-to-soil and for paint-to-soil would be nearly the same, 0.56 versus 0.565, respectively. By comparing tests B3a, B7a, and B5a, there is also evidence that the coefficient of friction produced by the antiskid-coated mat on soil is higher than the coefficient of friction produced by the paint-coated mat on soil. In each of these three tests, an average force of approximately 20,000 lb was applied to the load cart to skid the tire. In tests B3a and B7a, the paint-to-soil contact transferred an average force of 9,900 and 7,000 lb, respectively, to the anchor; whereas a force of only 1,500 lb was transferred to the anchor through the antiskid-to-soil contact in test B5a. In other words, the antiskid-coated surface was effectively preventing transfer of the force to the anchor.

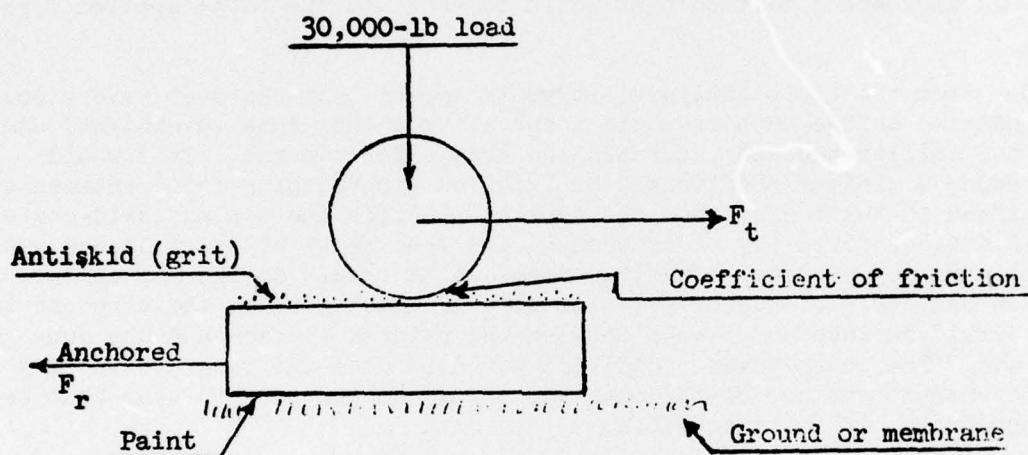
10. From Incl 4 in the A-series (tests 1a, 3a, and 7a), average forces of 11,800 to 13,500 lb were transmitted to the anchored dynamometer when the tire was skidded on the antiskid-coated mat surfaces. The average force applied to skid the tire in these tests was 20,500 lb. However, average forces of only 200 to 800 lb (tests A2a, A4a, and A8a) were transmitted to the anchored dynamometer when the tire was skidded on a painted surface. The average forces required to skid the tire in the latter tests were in the range of 13,000 to 17,500 lb per Incl 4.

11. In the B-series (tests 1a, 3a, and 7a), average forces from 5,500 to 9,900 lb were transmitted to the anchored dynamometer when the tire was skidded on the antiskid-coated mat surfaces (Incl 13). The average force applied to skid the tire in these tests ranged from 20,500 to 21,800 lb. However, average forces of only 200 to 500 lb (tests B2a, B4a, and B8a) were transmitted to the anchored dynamometer when the tire was skidded on a painted surface. The average forces required to skid the tire in the latter tests were in the range of 14,200 to 15,000 lb. This indicates that the antiskid coating in contact with the underlying soil or membrane will prevent mat movement when a force skids a tire on a painted surface as tested in the dry condition.

12. For tests 5a and 5b of the A- and B-series, the bottom sides of the XM18 mats were coated by hand rollers using Fuller 201 antiskid and 408 converter materials. (The topsides were factory coated with antiskid.) The panels were allowed to cure for a minimum of two days at ambient temperature of approximately 58°F or higher before the skid tests were performed. In tests A5a and B5a, average forces of 22,500 and 20,500 lb, respectively, were required to skid the tire, and an average force of only 1,500 lb was transmitted to the anchored dynamometer during each test. In tests A5b and B5a (mat not anchored), the mat did not move during the test when an average force of 21,000 lb was applied to skid the tire approximately 9 ft on the antiskid mat surface. These test data indicate that antiskid on the bottom of the mat will transfer a minimum force (1,500 lb) to be anchored when a 30,000-lb load on a C-5A

tire inflated to 100 psi is skidded on an antiskid-coated mat surface. The above data were generally duplicated using T11 mat nested bottom-to-bottom. The T11 mat has 0.05-in. lands (protrusions) on the antiskid-coated upper surface. By using the nesting arrangement, the contact surfaces of the mats were duplicates of each other. Comparisons of tests A5 (no lands) with A6 (with lands) and B5 (no lands) with B6 (with lands) show that no appreciable increase in the coefficients of friction could be attributed to the lands on the surface that were in contact with the substrata.

13. A schematic diagram of the anchored mat skid test and symbols are shown below.



Test data shown below were extracted from Incls 4 and 13. In each test, the mats were in normal placement position (antiskid-coated surface up, painted surface down).

Test	F_t	μ_a	F_r	Remarks
A1a	20,500	0.68	11,800	Mat on membrane
A3a	20,500	0.68	12,500	Mat on membrane
A7a	20,500	0.68	13,500	Mat on membrane
			Avg 12,600	
B1a	20,500	0.68	5,500	Mat on soil
B3a	21,800	0.72	9,000	Mat on soil
B7a	20,700	0.69	7,000	Mat on soil
			Avg 7,167	

14. Anchor forces required to restrain the mats were much higher when the painted surface was in contact with the membrane than when the painted surface was in contact with the soil (12,600 versus 7,170 lb). Comparing these average values, 42 percent more force was transferred to

the mat anchors when the painted mat surface was on membrane than when the painted mat surface was on soil. The force transmitted to the anchor when the mat was on the membrane was also 33 percent higher than the value used in the example in paragraph 2. However, the force transmitted to the anchors when the mat was in contact with the soil was near the value computed in the example in paragraph 2. Thus, the lower the coefficient of friction of the painted surface used for computation, the higher the indicated anchor forces would be and would approach the values measured in actual tests shown in the tabulation in paragraph 13. Assuming that the painted mat surface and subgrade were wet and the coefficient of friction of the painted surface, μ_p , to soil or membrane approached zero, the force, F_r , recorded by the anchored dynamometer would approach a maximum that would be equal to the total applied force, F_t .

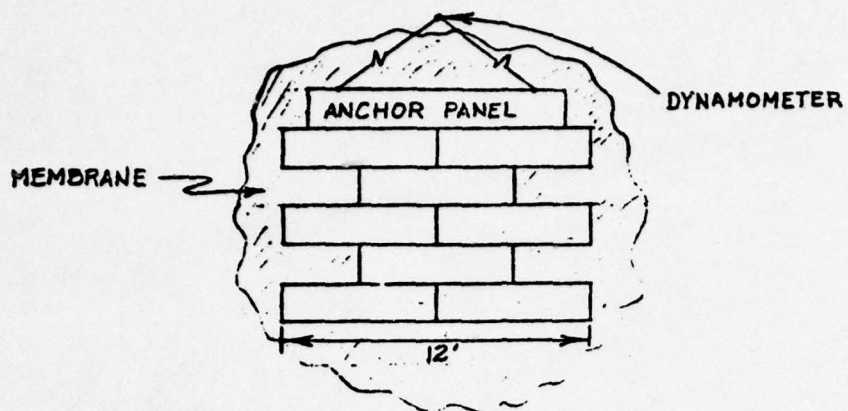
15. From the above analysis, it would appear that the most severe load condition on the anchors would occur after a long rain (overnight) when water infiltrated and saturated the area under the mat. This would produce a minimum coefficient of friction (approaching zero) between the painted bottom surface and the subgrade. After the top antiskid-coated mat surface dried (by midafternoon) and when heavy aircraft landed with full braking efforts, a maximum force would result on the mat surface when the coefficients of friction were greatest between the tire and the antiskid surface and lowest between the painted surface and the subgrade. The least severe condition would be when the subgrade was dry and the top surface of the mats was muddy and wet, a condition that seems improbable, if not impossible.

16. Conclusions. The coefficient of friction between the tire and the antiskid-coated surface of the mat was greater than any other contacting surfaces tested. The lowest coefficient of friction was between the tire and the painted surface. Forces transmitted to the anchors when the mats were placed normally and on a membrane were considerably larger than when the mats were placed normally and directly on soil (12,600 versus 7,167 lb). Antiskid on both sides of the mats reduced the force transmitted to the anchor to forces in a range of nearly zero to a few hundred pounds. The addition of antiskid coating and lands 0.05 in. high (as on the T11 mats) on both sides of the mats did not reduce the force transmitted to the anchor any more than the reduction achieved by coating both sides of a smooth mat with antiskid compound. The WES data computed prior to these tests were comparable to the forces measured for mats on soil. However, these computations were not correct for a mat-on-membrane-on-soil situation as shown by the greater forces transmitted from a skidding tire to the anchors.

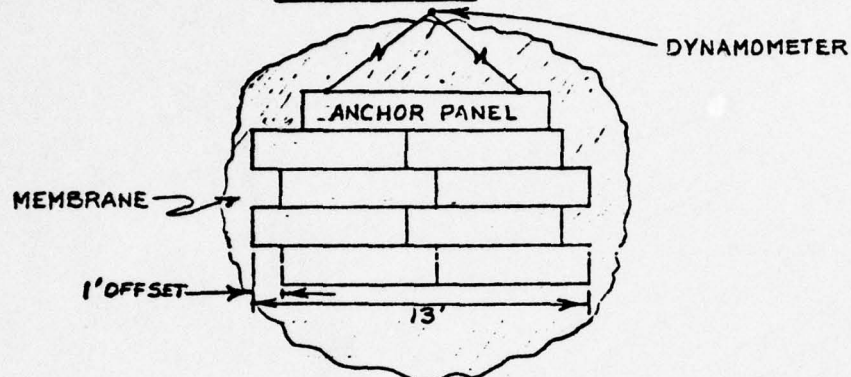


Nested Tll mats

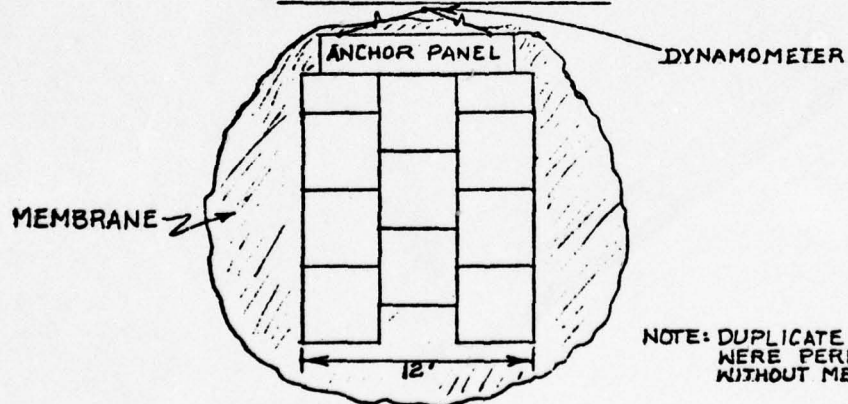
Incl 1



a. XM18 OR T11



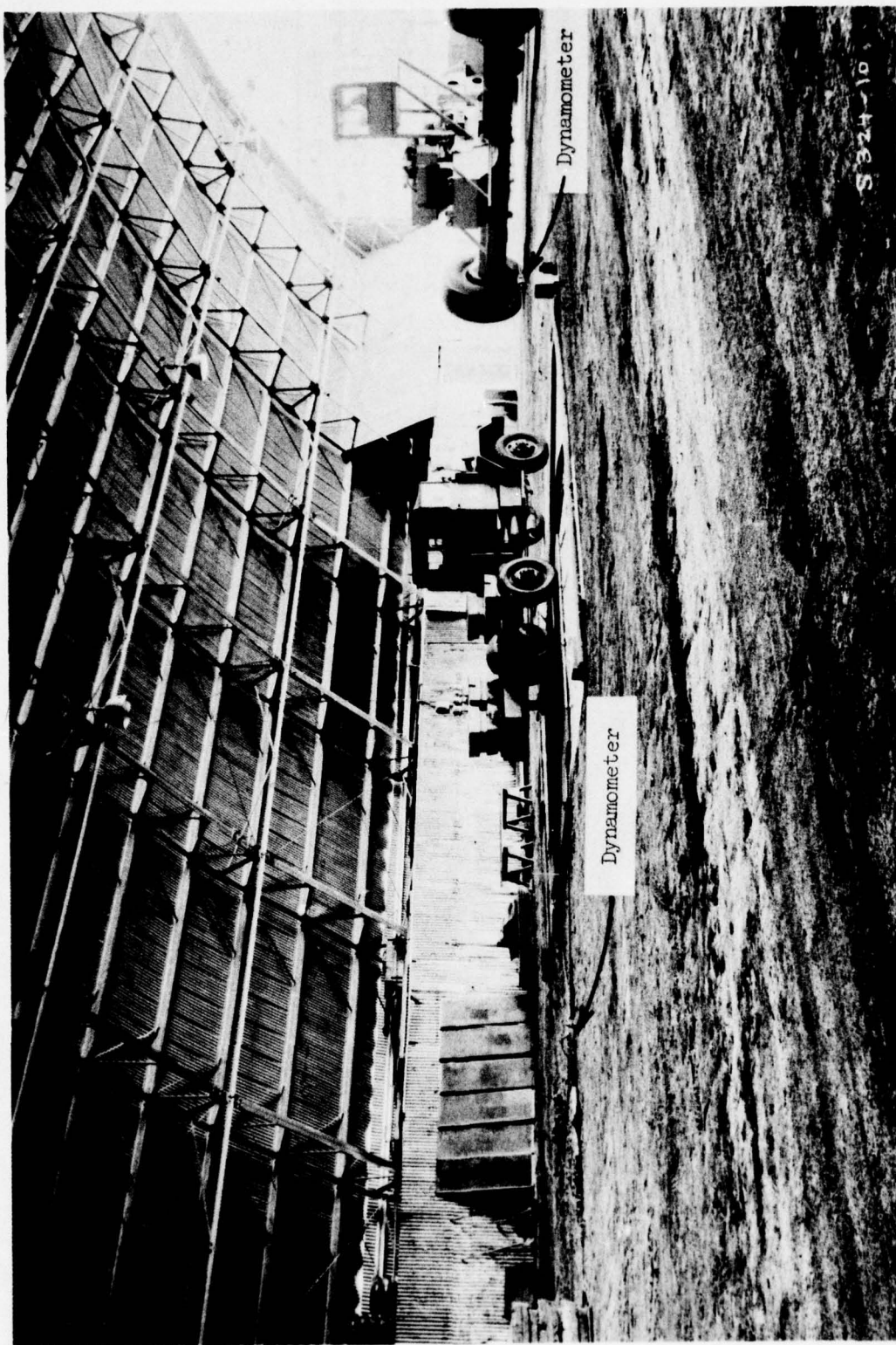
b. XM18 WITH 1-FT OFFSET



c. XM19

NOTE: DUPLICATE TESTS
WERE PERFORMED
WITHOUT MEMBRANE.

LAYOUTS FOR
XM18, T11, AND XM19 LANDING MATS



Typical arrangement of equipment for skid test

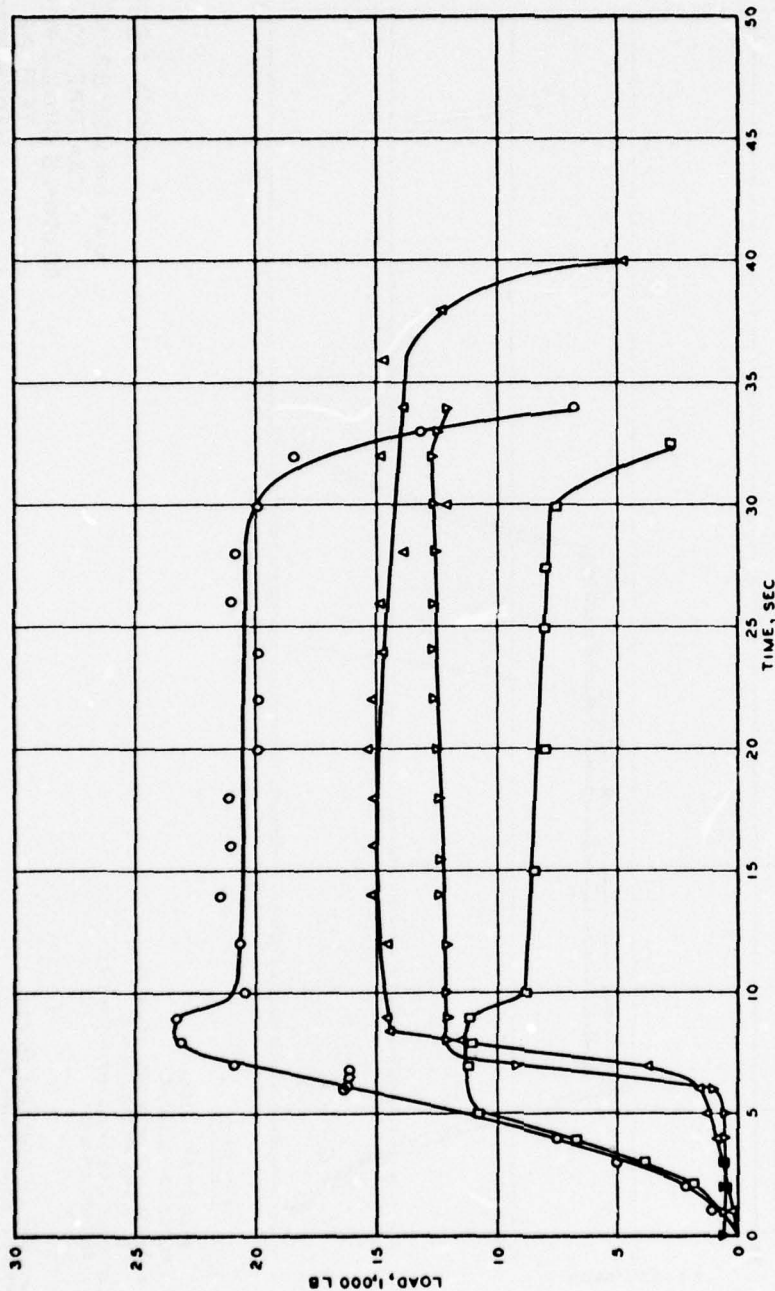
Test Series A: Mat on Membrane on Soil

Test No.*	Mat and Orientation	Vertical Load, lb	Force to Skid		Distance of Skid, ft	Coefficient of Friction, μ	Remarks
			Peak	Avg			
A1a	XM19 - antiskid up	30,000	23,400	20,500	9	0.68	Tire skidded on mat antiskid surface
A1b	XM19 - antiskid up	30,800	15,200	14,500	7	0.47	Mat (paint) skidded on membrane
A2a	XM19 - paint up	30,000	14,500	13,000	9-1/3	0.43	Tire skidded on mat paint
A2b	XM19 - paint up	30,000	14,300	13,500	6-1/2	0.45	Tire skidded on mat paint. Mat did not move.
A3a	XM18 - antiskid up (normal offset)	30,000	23,300	20,500	9-1/2	0.68	Tire skidded on mat antiskid surface
A3b	XM18 - antiskid up (normal offset)	30,600	20,500	17,500	6-1/2	0.57	Mat (paint) skidded on membrane
A4a	XM18 - paint up (normal offset)	30,000	19,700	17,500	4-3/4	0.58	Tire skidded on mat paint
A4b	XM18 - paint up (normal offset)	30,000	18,600	16,500	5-2/3	0.55	Tire skidded on mat paint. Mat did not move
A7a	XM18 - antiskid up (1-ft offset)	30,000	23,000	20,500	8	0.68	Tire skidded on mat antiskid surface
A7b	XM18 - antiskid up (1-ft offset)	30,600	16,500	15,000	7	0.49	Mat (paint) skidded on membrane
A8a	XM18 - paint up (1-ft offset)	30,000	15,800	15,400	9	0.51	Tire skidded on mat paint
A8b	XM18 - paint up (1-ft offset)	30,000	15,200	14,600	8	0.49	Tire skidded on mat paint. Mat did not move
A5a	XM18 - antiskid both sides	30,000	25,800	22,500	9	0.75	Tire skidded on mat antiskid surface
A5b	XM18 - antiskid both sides	30,000	23,000	21,000	9-1/3	0.70	Tire skidded on mat antiskid surface. Mat did not move on membrane
A6a	T11 - antiskid both sides	30,000	27,500	23,000	8-1/3	0.76	Tire skidded on mat antiskid surface
A6b	T11 - antiskid both sides	30,000	26,800	22,600	6	0.75	Tire skidded on mat antiskid surface. Mat did not move on membrane

* In all a-tests, the mats were anchored with a 20,000-lb dynamometer and readings are given below:

Test No.	Force to Anchor, lb		Remarks
	Peak	Avg	
A1a	12,600	11,800	Antiskid up, paint down (normal)
A2a	300	200	Paint up, antiskid down
A3a	12,900	12,500	Antiskid up, paint down (normal)
A4a	1,000	800	Paint up, antiskid down
A5a	3,200	1,500	Antiskid up and down
A6a	5,500	2,500	Antiskid up and down
A7a	14,000	13,500	Antiskid up, paint down (normal)
A8a	500	250	Paint up, antiskid down

The mats were not anchored in the subseries b-tests.

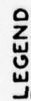






LEGEND

- FORCE TO SKID TIRE
- △ FORCE TO HOLD MAT
- DIFFERENCE BETWEEN TIRE SKID FORCE AND ANCHOR FORCE
- ◇ FORCE ON LOAD CART WHEN MAT SKIDDED ON MEMBRANE

NOTE: XM19 MAT ON MEMBRANE ON SOIL.
ANTISKID UP, PAINT DOWN.

SKID TEST
MAT ON MEMBRANE ON SOIL
CSA TIRE, 100 PSI
30,000-LB SINGLE-WHEEL LOAD
TEST A1
MARCH 1972

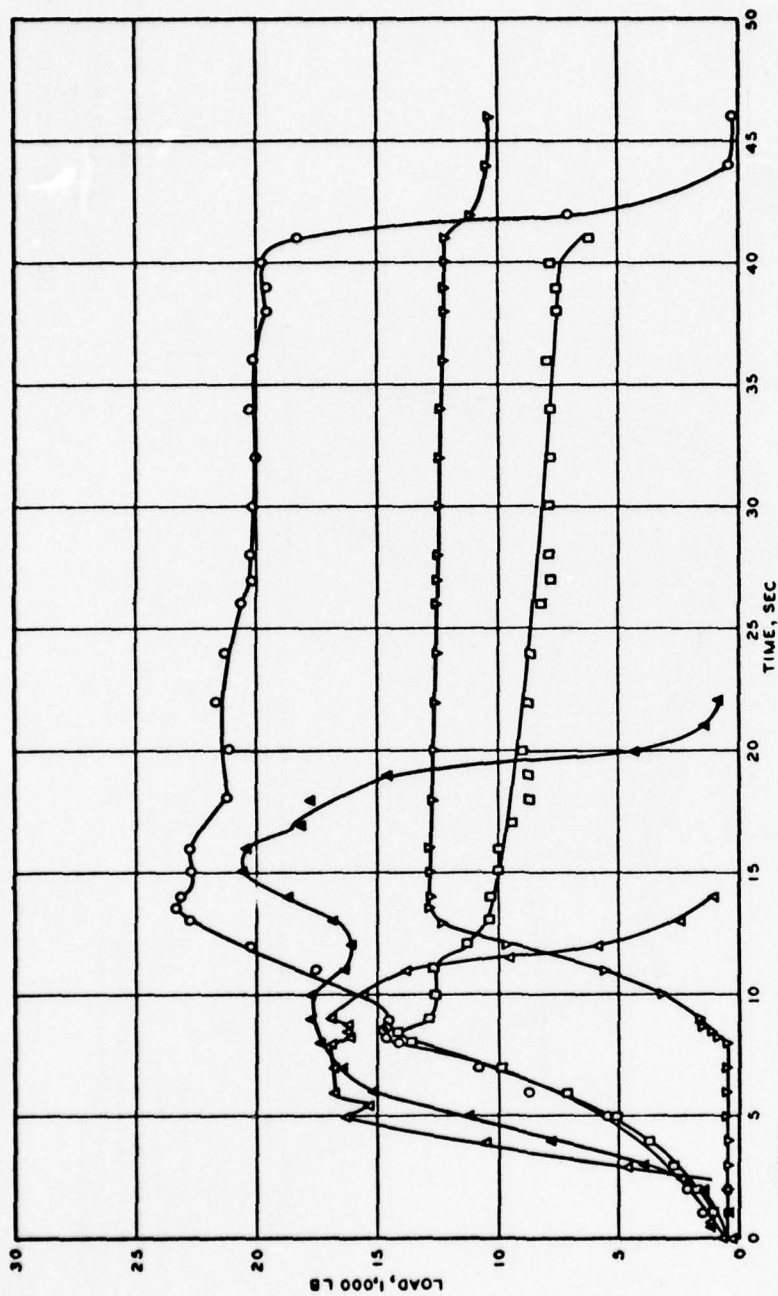


 FORCE TO SKID TIRE.
 FORCE TO HOLD MAT.
 a. DIFFERENCE BETWEEN TIRE SKID
FORCE AND ANCHOR FORCE
 b. FORCE ON LOAD CART WHEN TIRE
SKIDDED ON MAT

NOTE: XM19 MAT ON MEMBRANE ON SOIL.
ANTISKID DOWN, PAINT UP

SKID TEST

MAT ON MEMBRANE ON SOIL
CSA TIRE, 100 PSI
30,000-LB SINGLE-WHEEL LOAD
TEST A2
MARCH 1972

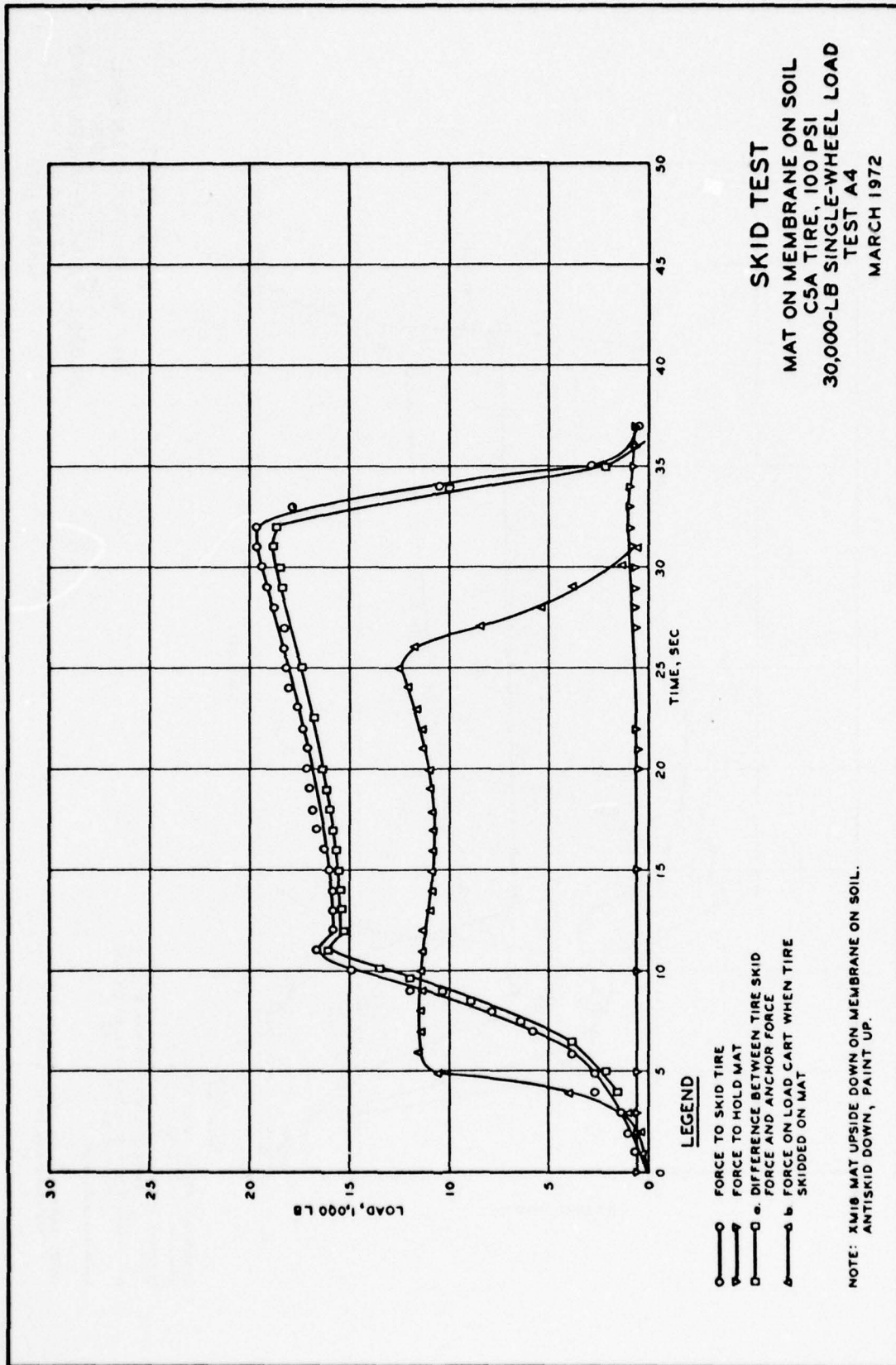


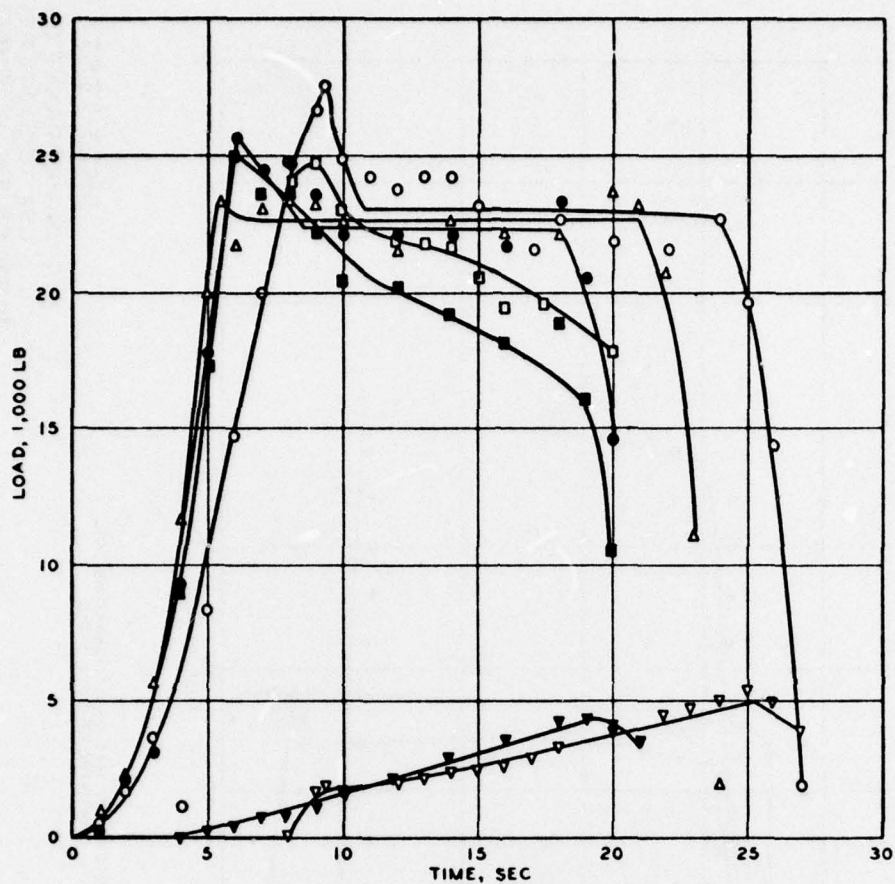
LEGEND

- O FORCE TO SKID TIRE
- V FORCE TO HOLD MAT
- D DIFFERENCE BETWEEN TIRE SKID FORCE AND ANCHOR FORCE
- A FORCE ON LOAD CART WHEN MAT SKIDDED ON MEMBRANE
- B RETEST

NOTE: XM18 MAT ON MEMBRANE ON SOIL. ANTISKID UP, PAINT DOWN.

SKID TEST
MAT ON MEMBRANE ON SOIL
C5A TIRE, 100 PSI
30,000-LB SINGLE-WHEEL LOAD
TEST A3
MARCH 1972



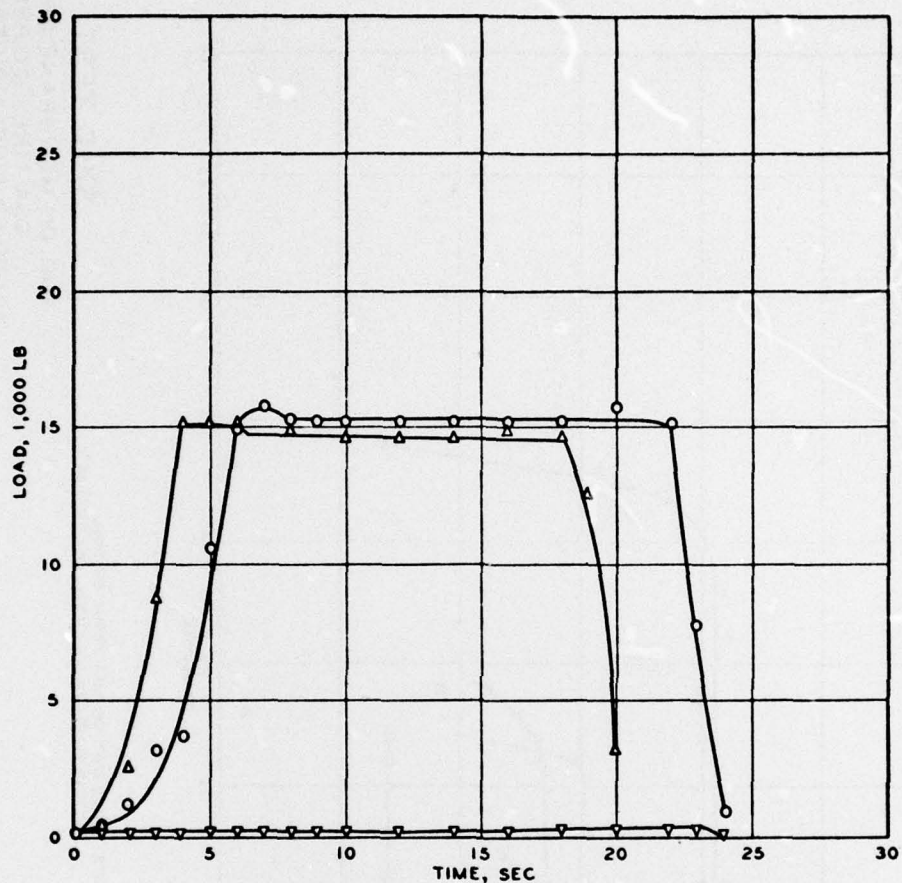


LEGEND

- FORCE TO SKID TIRE, TEST 1
- ▽—▽ FORCE TO HOLD MAT, TEST 1
- FORCE TO SKID TIRE, TEST 2
- ▼—▼ FORCE TO HOLD MAT, TEST 2
- a. DIFFERENCE IN TESTS 1
- DIFFERENCE IN TESTS 2
- △—△ b. FORCE ON LOAD CART WHEN TIRE SKIDDED ON MAT

NOTE: T11 MAT ON MEMBRANE ON SOIL.
ANTISKID UP AND DOWN.

SKID TEST
MAT ON MEMBRANE ON SOIL
C5A TIRE, 100 PSI
30,000-LB SINGLE-WHEEL LOAD
TEST A6
MARCH 1972



LEGEND

- FORCE TO SKID TIRE
- ▽—▽ FORCE TO HOLD MAT
- △—△ b. FORCE ON LOAD CART WHEN TIRE SKIDDED ON MAT

NOTE: XM18 MAT ON MEMBRANE ON SOIL.
ANTISKID DOWN, 1-FT OFFSET.

SKID TEST
MAT ON MEMBRANE ON SOIL
C5A TIRE, 100 PSI
30,000-LB SINGLE-WHEEL LOAD
TEST A8
MARCH 1972

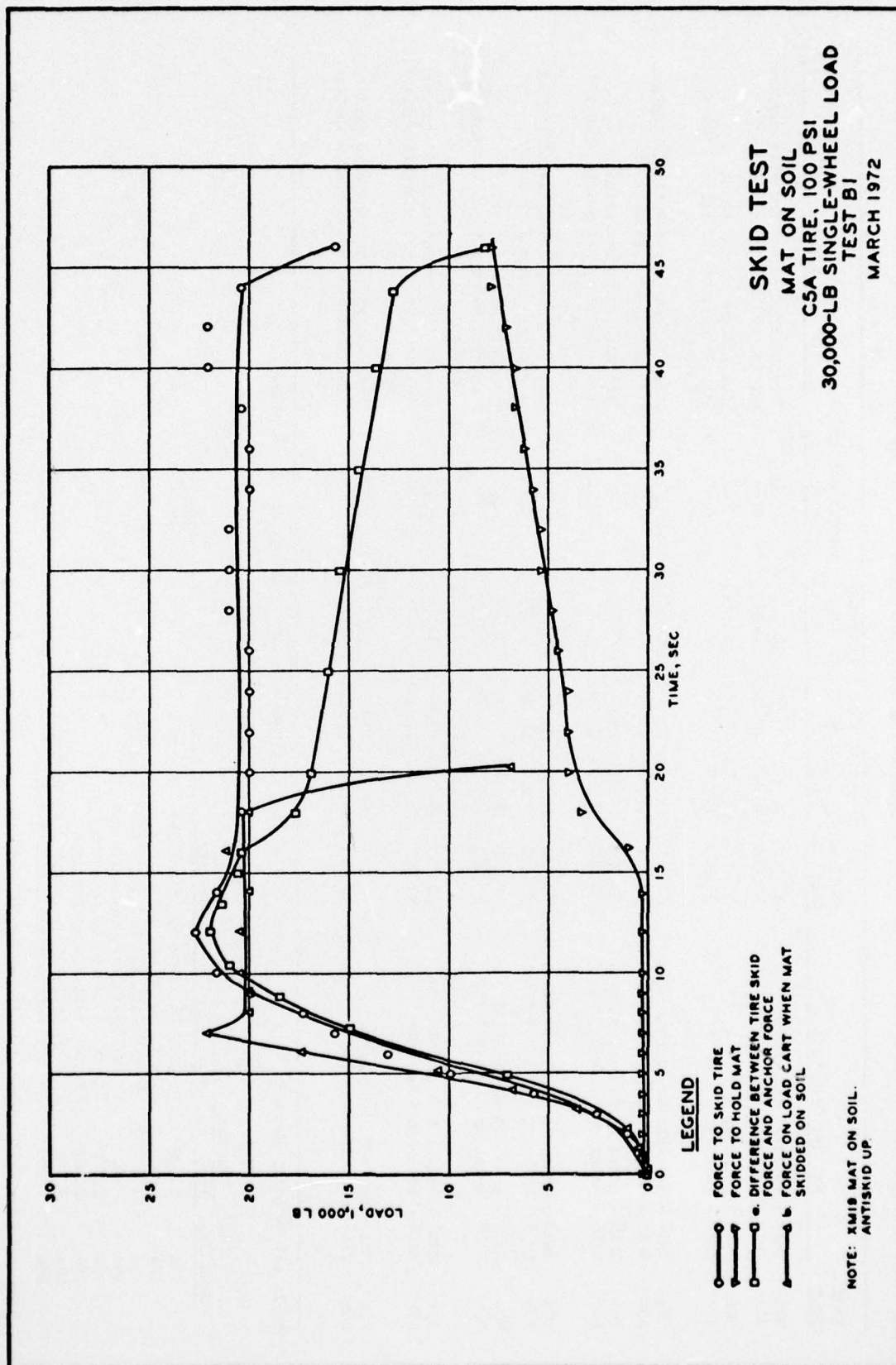
Test Series B: Mat on Soil

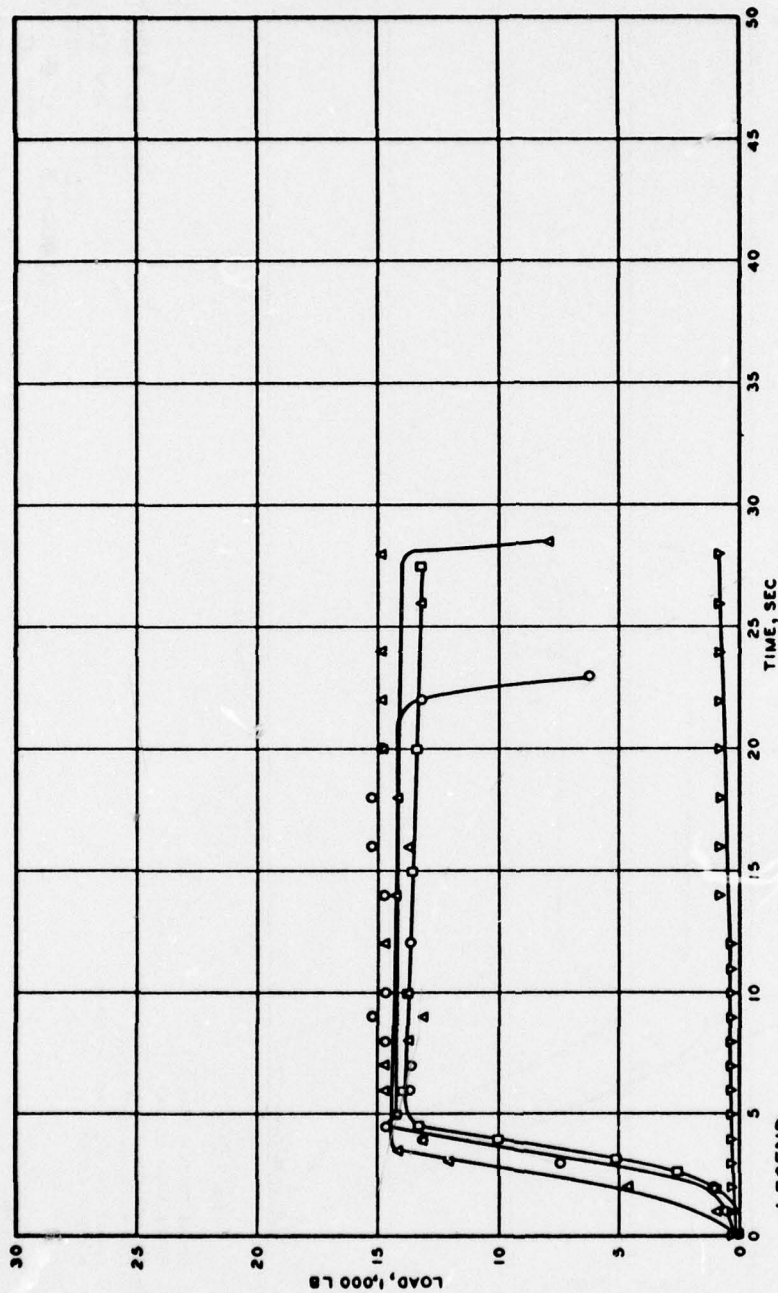
Test No.*	Mat and Orientation	Vertical Load, lb	Force to Skid lb		Distance of Skid ft	Coefficient of Friction, μ	Remarks
			Peak	Avg			
B1a	XM19 - antiskid up	30,000	22,500	20,500	11	0.68	Tire skidded on mat antiskid surface
B1b	XM19 - antiskid up	30,800	22,000	20,000	6-2/3	0.65	Mat (paint) skidded on soil
B2a	XM19 - paint up	30,000	15,200	14,200	11-1/3	0.47	Tire skidded on mat paint
B2b	XM19 - paint up	30,000	14,700	14,300	11	0.48	Tire skidded on mat paint. Mat did not move
B3a	XM18 - antiskid up (normal offset)	30,000	23,400	21,800	8-5/6	0.72	Tire skidded on mat antiskid surface
B3b	XM18 - antiskid up (normal offset)	30,600	17,300	17,300	4-1/3	0.57	Mat (paint) skidded on soil
B4a	XM18 - paint up (normal offset)	30,000	16,800	15,000	9-2/3	0.50	Tire skidded on mat paint
B4b	XM18 - paint up (normal offset)	30,000	16,500	15,000	8	0.50	Tire skidded on mat paint. Mat did not move
B7a	XM18 - antiskid up (1-ft offset)	30,000	21,500	20,700	8-2/3	0.69	Tire skidded on mat antiskid surface
B7b	XM18 - antiskid up (1-ft offset)	30,600	17,800	17,000	5-1/3	0.56	Mat (paint) skidded on soil
B8a	XM18 - paint up (1-ft offset)	30,000	16,200	15,000	7-5/6	0.50	Tire skidded on mat paint
B8b	XM18 - paint up (1-ft offset)	30,000	16,600	14,800	8-1/2	0.49	Tire skidded on mat paint. Mat did not move
B5a	XM18 - antiskid both sides	30,000	21,000	20,500	8-2/3	0.68	Tire skidded on mat antiskid surface
B5b	XM18 - antiskid both sides	30,000	24,000	21,000	9	0.70	Tire skidded on mat antiskid surface. Mat did not move
B6a	T11 - antiskid both sides	30,000	26,100	22,000	7-1/3	0.73	Tire skidded on mat antiskid surface
B6b	T11 - antiskid both sides	30,000	24,200	21,700	5-1/3	0.72	Tire skidded on mat antiskid surface. Mat did not move

* In all a-tests, the mats were anchored with a 20,000-lb dynamometer and readings are given below:

Test No.	Force to Anchor, lb		Remarks
	Peak	Avg	
B1a	7,800	5,500	Antiskid up, paint down (normal)
B2a	800	500	Paint up, antiskid down
B3a	11,500	9,900	Antiskid up, paint down (normal)
B4a	200	200	Paint up, antiskid down
B5a	2,000	1,500	Antiskid up and down
B6a	2,500	1,500	Antiskid up and down
B7a	9,500	7,000	Antiskid up, paint down (normal)
B8a	200	200	Paint up and antiskid down

The mats were not anchored in the subseries b-tests.



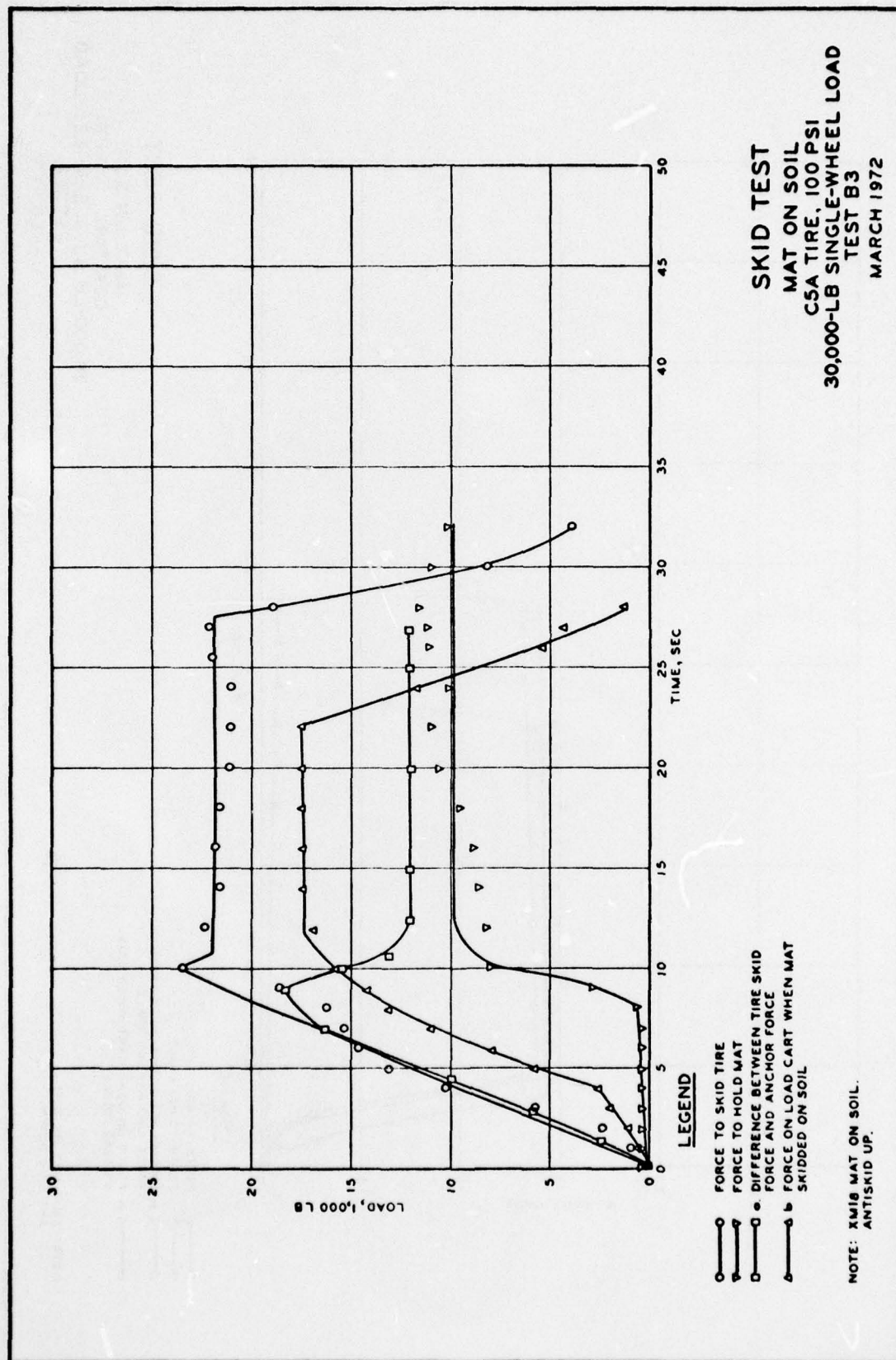


LEGEND

- FORCE TO SKID TIRE
- △ FORCE TO HOLD MAT
- DIFFERENCE BETWEEN TIRE SKID FORCE AND ANCHOR FORCE
- ◇ FORCE ON LOAD CART WHEN TIRE SKIDDED ON MAT

NOTE: XM19 MAT ON SOIL.
ANTISKID DOWN.

SKID TEST
MAT ON SOIL
C5A TIRE, 100 PSI
30,000-LB SINGLE-WHEEL LOAD
TEST B2
MARCH 1972

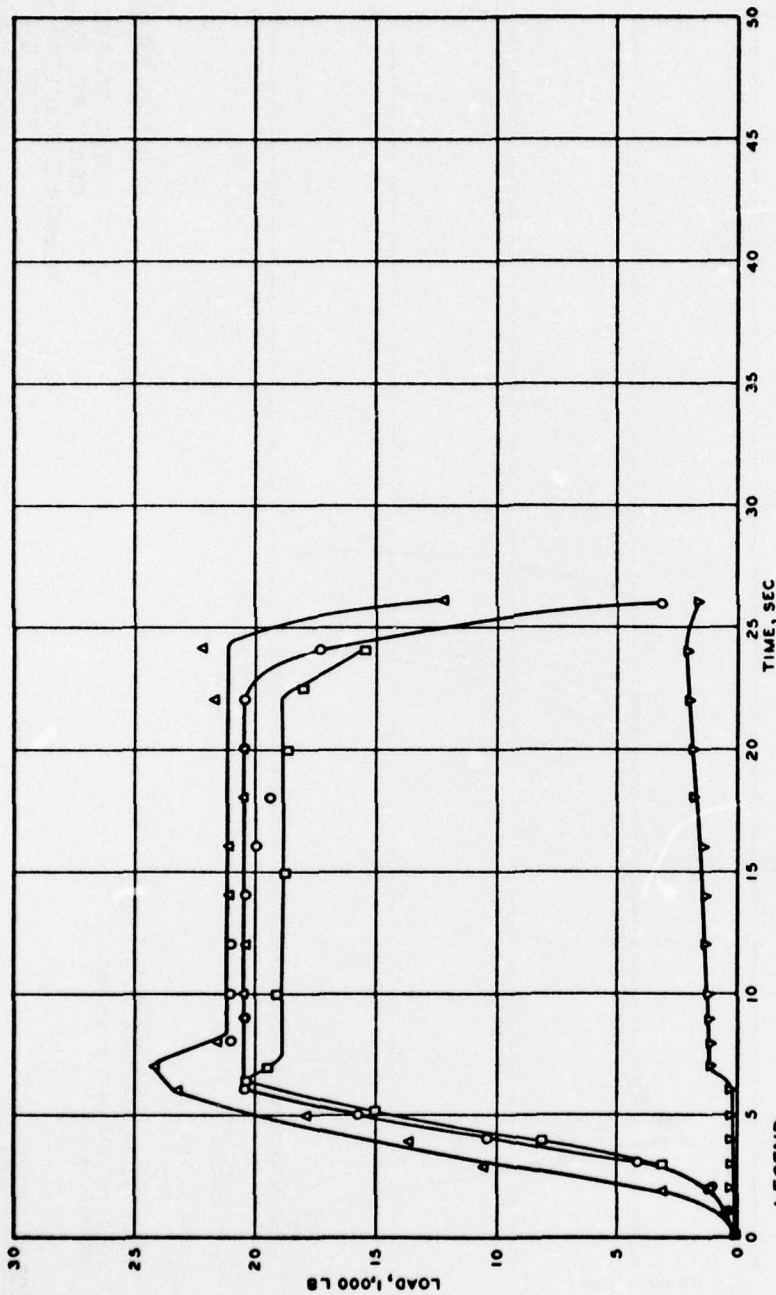




a FORCE TO SKID TIRE
b FORCE TO HOLD MAT
• DIFFERENCE BETWEEN TIRE SKID
FORCE AND ANCHOR FORCE
c FORCE ON LOAD CART WHEN TIRE
SKIPPED ON MAT

NOTE: XMI8 MAT UN SOIL.
ANTISKID DOWN.

SKID TEST
MAT ON SOIL
CSA TIRE, 100 PSI
30,000-LB SINGLE-WHEEL LOAD
TEST B4
MARCH 1972



SKID TEST
MAT ON SOIL
CSA TIRE, 100 PSI
30,000-LB SINGLE-WHEEL LOAD
TEST B5
MARCH 1972

LEGEND
 ○ FORCE TO SKID TIRE
 △ FORCE TO HOLD MAT
 □ DIFFERENCE BETWEEN TIRE SKID
 AND ANCHOR FORCE
 ◆ FORCE ON LOAD CART WHEN TIRE
 SKIDDED ON MAT
 ▼ FORCE ON LOAD CART WHEN TIRE
 SKIDDED ON MAT

NOTE: XM18 MAT ON SOIL.
 ANTISKID UP AND DOWN.



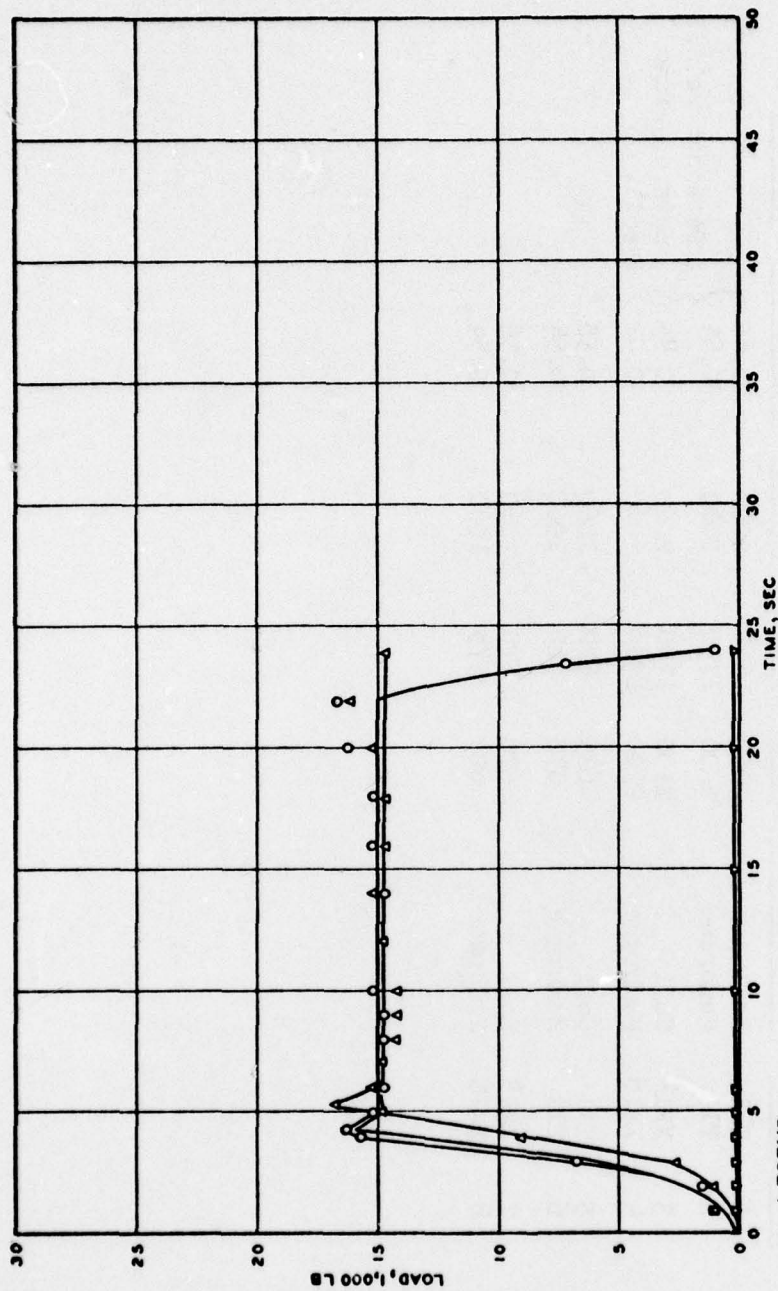
SKID TEST

**MAT ON SOIL
CSA TIRE, 100 PSI
30,000-LB SINGLE-WHEEL LOAD
TEST B6**

MARCH 1972

a ○ — ○ FORCE TO SKID TIRE
b ▼ — ▲ FORCE TO HOLD MAT,
 ○ — ○ DIFFERENCE BETWEEN TIRE SKID
 FORCE AND ANCHOR FORCE
c ▲ — ▼ FORCE ON LOAD CART WHEN TIRE
 SKIDDED ON MAT

**NOTE: TII MAT ON SOIL.
ANTISKID UP AND DOWN.**



LEGEND

- FORCE TO SKID TIRE
- FORCE TO HOLD MAT
- △ DIFFERENCE BETWEEN TIRE SKID FORCE AND ANCHOR FORCE
- ◇ FORCE ON LOAD CART WHEN TIRE SKIPPED ON MAT

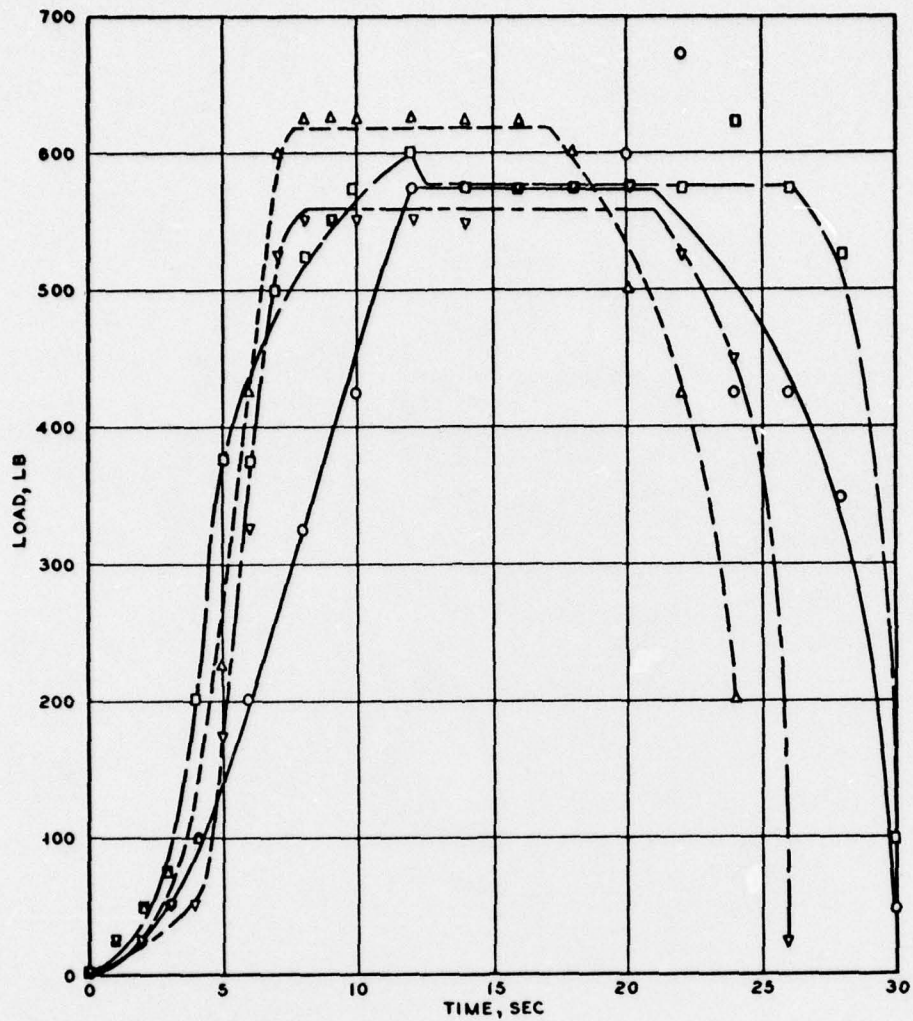
NOTE: XM18 MAT ON SOIL.
ANTISKID UP, 1-FT OFFSET.

SKID TEST
MAT ON SOIL
CSA TIRE, 100 PSI
30,000-LB SINGLE-WHEEL LOAD
TEST B8
MARCH 1972

Mats Skidded on Membrane and Soil

Antiskid Surface Down

Test	Type Mat	Surface under Mat	Force, lb		Vertical Load lb	Coefficient of Friction		Remarks
			Peak	Avg.				
1	T11	Soil	2050	1750	2060	0.85	}	Data not valid; mats dug into soil.
2	T11	Membrane	2000	1750	2060	0.85		
3	XM18	Soil	2100	1750	2060	0.85		
4	XM18	Membrane	2200	1900	2060	0.92		
5	T11	Soil	625	620	1060	0.56	}	
6	T11	Membrane	570	560	1060	0.54		
7	XM18	Soil	670	575	1060	0.56	}	
8	XM18	Membrane	620	575	1060	0.54		



LEGEND

- XM18 ON SOIL, TEST 1
- XM18 ON MEMBRANE, TEST 2
- △—△ T11 ON SOIL, TEST 1
- ▽—▽ T11 ON MEMBRANE, TEST 2

SKID TEST
 ONE HALF PANEL UNITS
 1000 LB LOAD ANTISKID DOWN
 MARCH 1972